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ABSTRACT

Data were collected from approximately 1,600 teachers to get a statistical picture of Australian science teachers. Questionnaires provided information on sex, age, qualifications, experience, mobility, teaching conditions, lesson preparation, professional development, perceived syllabus freedom, and professional association affiliation. Results presented the average Australian science teacher as a 30-year-old male with 3.5 years tertiary education, having studied physics, chemistry, and biology to the first year level. Teaching experience was 8.5 years and mobility was rather high. Teachers spent 6.5 hours per week preparing lessons and 4 hours marking tests. They felt need for refresher courses, read science journals occasionally, belonged to the state teachers union but had joined science teachers associations in only 40 percent of the cases. (SM)

IEA (AUSTRALIA) REPORT

1973:3*

A statistical picture of Australian science teachers - some results from the IEA Science Project

Malcolm J. Rosier

IEA (International Association for the Evaluation of Educational Achievement) is an international educational research organization.
ACER (Australian Council for Educational Research) is the National Centre for IEA activities in Australia.

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A Statistical Picture of Australian Science Teachers — some results from the IEA Science Project

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Introduction

This article sets out a statistical picture of the teachers of science in Australian secondary schools.

The data on which the article is based were gathered in 1970 as part of the IEA Science Project.[1] The IEA project is a large international educational research project to investigate relationships between the science achievement of students, and various home and school factors on which the achievement depends. The first cross-national results were recently published by Comber & Keeves (1973), and summarised briefly in this journal (Rosier, 1973c).

The science achievement was measured using a series of special science tests. The same tests, appropriately translated, were used in all the countries.

The students also answered a series of questionnaires to provide information so that reasons for differences in science achievement could be investigated. The school principals completed a questionnaire about administrative, financial and pedagogical aspects of their schools. And all the science teachers in the participating schools were also asked to provide information. This article is based on data obtained from the IEA teacher and school questionnaires.[2]

Australian student populations and samples

For Australia we defined two populations. Population II contained 14-year-old students. Population IV contained final-year secondary (pre-tertiary) students. This article will consider only the Population II students, the schools in which they were located, and the science teachers in these schools.

Table 1 sets out the scope of the project in terms of the number of schools, science teachers and students in the Australian Population II sample.

Table 1 : Number of schools, science teachers and students in the Australian Population II sample

	NSW	Vic.	Qld.	SA	WA	Tas.
Number of schools	37	39	38	38	37	32
Number of students	925	932	898	909	888	755
Number of science teachers	254	265	279	368	265	207

It can be seen that the total Australian sample was derived from 6 separate state samples, each of which was about the same size.

1. IEA is the International Association for the Evaluation of Educational Achievement. It is an autonomous association of research centres in about 20 countries, which sponsors and coordinates cross-national studies in education.
2. Some other Australian results are included in Rosier (1972a, 1972b, 1973a and 1973b).

The sample of students in each state was a two-stage random sample. At the first stage schools were selected from the complete list of relevant schools in the state with a probability proportional to the number of Population II students they contained. At the second stage a group of 25 or so students was chosen at random from all the 14-year-old students in the sample schools.

The sample for each state contained students from government, catholic and independent schools in the same proportion as these students existed in the state population overall. Similarly, metropolitan and non-metropolitan students were proportionately represented. The number of sample schools was not proportional to the number of schools of different types in the population overall, but to the number of 14-year-old students in the different types of schools.

Australian teacher sample

The teacher sample was designed to consist of all teachers of science in the sample schools. The response rate was higher than 95%. This indicates only a very small 'loss' of teachers from the sample; that is teachers who did not complete the IEA questionnaires due to absence from school, etc.

The teacher sample was not a random sample of science teachers of 14-year-old students. It was composed of all teachers of science in the schools from which the IEA Population II (14-year-old) students were drawn. We are not describing the science teachers of 14-year-olds, but the teachers of science in schools where there are 14-year-olds. We have not linked teachers to students. Instead we have linked the group of teachers in the school with the group of students in the school.

Most types of Australian secondary schools are schools containing 14-year-olds. The notable exception is Tasmania with its government matriculation colleges. This should be borne in mind when considering the Tasmania data in this paper.

The definition of a teacher of science for IEA purposes, was a teacher who taught at least one period of science per week. Later analyses of the Australian data will differentiate between teachers who taught only a few periods of science per week from those whose main teaching subject was science.

Another general comment should be noted about the results in this article. The data are based on the responses of school principals and science teachers. For questions of a factual nature we assume that the data are fairly accurate. To the extent that respondents needed to provide estimates, make inferences or state opinions the data may be less accurate.

School size

Table 2 indicates the range of school sizes in the 6 states in terms of the enrolment of Population II (14-year-old) students. Several categories of student population are shown, and the percentage of students in each category is indicated.

The mean enrolment of 14-year-olds in the schools of each of the states is shown in brackets. The numbers of schools on which the data are based are

Table 2 : School enrolment of Population II students

	NSW %	Vic. %	Qld. %	SA %	WA %	Tas. %
0–100 students	22	25	29	21	22	31
101–200 students	49	67	16	41	32	31
201–300 students	24	8	26	25	8	38
301–400 students	5		24	13	27	
401–500 students			5		11	
(Mean enrolment)	(174)	(132)	(221)	(179)	(228)	(151)
(Number of schools)	(37)	(39)	(38)	(37)	(37)	(32)

also included in brackets, so that the response rate for each question can be gauged.

It can be seen that the Queensland and Western Australia schools had more schools with large 14-year-old enrolments, and larger mean enrolments at this level. Victoria had more smaller schools, and a lower mean enrolment. The 14-year-old cohort in a school may also be used to estimate the intake enrolment of the school, and the size of the first few secondary level grades in the school.

Sex and age of science teachers

Table 3 shows the percent of male and female science teachers. There are considerable differences between states, highlighted by the calculation of ratios. The development of these differences probably occurred over many years. It is not the purpose of this article to attempt to explain these differences, but merely to note them.

Table 3 : Sex of science teachers

	NSW %	Vic. %	Qld. %	SA %	WA %	Tas. %
Males	55	66	63	74	70	78
Female	45	34	37	26	30	22
(Ratio)	(1.2)	(1.9)	(1.7)	(2.8)	(2.3)	(3.5)
(Number of teachers)	(250)	(265)	(278)	(368)	(264)	(207)

The age of Australian science teachers is shown in Table 4. It is obvious that the Australian science teaching force was a young one.

Table 4 : Age of science teachers

	NSW %	Vic. %	Qld. %	SA %	WA %	Tas. %
27 years or younger	51	40	53	60	52	37
28–37 years	28	32	30	24	27	33
38–47 years	13	15	9	8	10	19
48–57 years	6	8	5	4	8	8
58 years or older	2	5	3	4	3	3
(Mean age in years)	(30)	(33)	(29)	(29)	(30)	(33)
(Number of teachers)	(250)	(265)	(279)	(367)	(265)	(207)

Of the 19 countries in the IEA Science Project, Australia has the highest proportion of science teachers aged 27 years and under. Table 5 displays the

data for some other countries on this factor. These data are taken from Table 4.10 in Comber & Keeves (1973).

Table 5 : Percentage of science teachers aged 27 years and under in other countries

Country	Science teachers aged 27 years and under %
Australia	50
England	32
Japan	11
New Zealand	35
Scotland	23
Sweden	16
USA	28

Qualifications of science teachers

If so many of the Australian science teachers are young, what are their tertiary qualifications? Table 6 shows the amount of tertiary (post-secondary) education of the Australian sample. The original question is included at the bottom of this table to provide a frame of reference for the data.

Table 6 : Number of years of tertiary education

	NSW %	Vic. %	Qld. %	SA %	WA %	Tas. %
None		1	1			
Up to 2 years	17	7	25	4	9	11
More than 2 years —up to 3 years	20	23	24	17	23	26
More than 3 years —up to 4 years	37	38	32	50	33	39
More than 4 years	26	31	18	29	35	24
(Mean number of years)	(3.6)	(3.9)	(3.3)	(4.0)	(3.9)	(3.7)
(Number of teachers)	(252)	(265)	(278)	(368)	(263)	(207)

Question: How many years of education did you receive after secondary school?. Include full-time education, and part-time education reduced to its full-time equivalent.

Although South Australia had the largest percentage of young science teachers (Table 4), this table shows that it had the highest proportion of teachers with more than 3 years tertiary education. By contrast, Queensland had a relatively large proportion of teachers with 2 years or less tertiary education.

Next we examine the nature of the science component of this tertiary education. Tables 7- 10 show the number of years of tertiary education in physics, chemistry, biology and geology. That is, they show the percentage of teachers who had studied these subjects at the 1st year tertiary level, 2nd year level, etc.

Table 7 : Level of tertiary education : physics

	NSW %	Vic. %	Qld. %	SA %	WA %	Tas. %
0 years	19	28	34	21	32	27
1 year	41	33	45	58	27	41
2 years	31	20	11	11	21	19
3 years	8	14	8	9	15	11
4 or more years	1	5	2	1	5	2
(Mean number of years)	(1.3)	(1.3)	(1.0)	(1.1)	(1.4)	(1.2)
(Number of teachers)	(251)	(263)	(278)	(367)	(259)	(206)

Question: How many years of full-time training (or its equivalent) have you completed at a post-secondary institution in physics?

Table 8 : Level of tertiary education : chemistry

	NSW %	Vic. %	Qld. %	SA %	WA %	Tas. %
0 years	15	28	29	22	28	32
1 year	28	33	37	43	35	33
2 years	31	17	19	13	19	14
3 years	20	13	13	19	14	16
4 or more years	6	9	2	3	4	5
(Mean number of years)	(1.7)	(1.4)	(1.2)	(1.4)	(1.3)	(1.3)
Number of teachers)	(248)	(263)	(277)	(367)	(259)	(205)

Question: How many years of full-time training (or its equivalent) have you completed at a post-secondary institution in chemistry?

Table 9 : Level of tertiary education : biology

	NSW %	Vic. %	Qld. %	SA %	WA %	Tas. %
0 years	25	52	46	35	42	47
1 year	22	21	25	40	32	21
2 years	28	10	18	11	12	11
3 years	14	12	8	10	7	14
4 or more years	11	5	3	4	7	7
(Mean number of years)	(1.6)	(1.0)	(1.0)	(1.1)	(1.0)	(1.1)
Number of teachers)	(252)	(262)	(279)	(366)	(261)	(204)

Question: How many years of full-time training (or its equivalent) have you completed at a post-secondary institution in biology (including botany and zoology)?

Table 10 : Level of tertiary education : geology

	NSW %	Vic. %	Qld. %	SA %	WA %	Tas. %
0 years	45	74	74	68	72	70
1 year	29	24	18	28	25	18
2 years	15	2	7	3	1	7
3 years	7		1	1	1	4
4 or more years	4				1	1
(Mean number of years)	(1.0)	(0.3)	(0.4)	(0.4)	(0.4)	(0.5)
Number of teachers)	(249)	(262)	(277)	(360)	(258)	(203)

Question: How many years of full-time training (or its equivalent) have you completed at a post-secondary institution in geology?

The patterns for physics and chemistry are similar. About a quarter of the teachers have done no tertiary physics or chemistry. Overall, teachers have an average of about one year's level of study in each of these subjects. About two-fifths of the teachers had done no tertiary study in biology. The average was about first year level, although New South Wales had a notably higher figure. Most teachers had not studied geology at tertiary level. Once again, the New South Wales figure was atypically higher.

Experience of science teachers

It would be expected that, since the science teaching force was young, it would also be inexperienced. Table 11 provides data to confirm this. As for Table 4, the first category is rather crowded. About half the science teachers had only 5 years or less teaching experience.

Table 11 : Total number of years of teaching experience

	NSW %	Vic. %	Qld. %	SA %	WA %	Tas. %
Up to 5 years	47	49	44	57	49	40
6–10 years	27	25	28	28	24	25
11–20 years	17	17	19	11	19	22
21–30 years	6	5	6	2	5	9
More than 30 years	3	4	3	2	3	4
(Mean number of years)	(8.5)	(8.7)	(8.8)	(7.0)	(8.6)	(10.2)
(Number of teachers)	(252)	(262)	(278)	(367)	(265)	(206)

The figure for South Australia in the first row is higher than for the other states. This is consistent with the high percentage of young teachers given in Table 4. Conversely, Tasmania had fewer young teachers, and fewer inexperienced teachers.

This relative inexperience is a significant characteristic of the Australian science teaching force. However this also means that many Australian teachers have received their training in tertiary science recently, and their science knowledge may be more up-to-date than their science teaching colleagues in other countries.

Stability of science teachers

Of more concern, from several points of view, is the mobility of the science teachers. Table 12 shows that about 85% of Australian science teachers had been in their present school for 5 years or less. Part of this high figure was due to the large number of teachers whose total teaching experience was 5 years of less, (as shown in Table 11).

Table 12 : Number of years in present school

	NSW %	Vic. %	Qld. %	SA %	WA %	Tas. %
Up to 5 years	84	85	85	86	88	81
6–10 years	10	10	11	11	8	15
11–20 years	6	3	3	3	4	2
21–30 years		2				1
More than 30 years			1			1
(Mean number of years)	(3.9)	(3.9)	(3.8)	(3.5)	(3.5)	(4.8)
(Number of teachers)	(253)	(263)	(276)	(366)	(263)	(207)

The implications for curriculum developers of this lack of stability are serious. The data indicate that curricula should not be developed which depend on a high degree of science teacher stability in the schools. The effects of low stability on student achievement, attitude and morale may also be serious. Alternatively attention should be directed to improving the stability.

Conditions for science teaching

The IEA Science Project also collected information about the conditions under which the science teachers were working in 1970.

One condition was the number of students in the laboratory practical classes. The school principal was asked, on the IEA school questionnaire, to state the average number of students accommodated in a laboratory for a practical science lesson. Table 13 shows the percentage of schools for which the average laboratory class size fell in various categories.

Table 13 : Size of laboratory practical classes

	NSW %	Vic. %	Qld. %	SA %	WA %	Tas. %
1–10 students			3			
11–20 students		23	5	33	11	23
21–30 students	11	28	29	11	35	68
More than 30 students	89	49	63	56	54	9
(Mean size)	(34)	(28)	(30)	(27)	(29)	(24)
(Number of schools)	(37)	(39)	(38)	(37)	(37)	(31)

Question: How many students, on the average, are accommodated in a laboratory for a practical science lesson?

The pattern differs considerably from state to state. Tasmania is notable for the low percentage of students in laboratory classes greater than 30, and New South Wales is notable for its high percentage.

The average size of a laboratory practical class may vary at different levels of the secondary school. If this were the case in an IEA school, the

principal was asked to answer in terms of the 14-year-old students when completing the IEA school questionnaire. The Table 13 figures may not represent the picture at the upper secondary level.

Another school condition about which IEA gathered information was the number of laboratory assistants per school. Table 14 displays this information. The average number of laboratory assistants per school was twice as high in South Australia as in the other 5 states. Excluding South Australia, two-fifths of the schools had no laboratory assistants.

Table 14 : Number of laboratory assistants per school

	NSW %	Vic. %	Qld. %	SA %	WA %	Tas. %
None	34	62	40	21	40	25
1	66	30	57	31	54	66
2		5	3	29	3	9
3		3		16		
4				3		
5					3	
(Mean number of laboratory assistants)	(0.7)	(0.5)	(0.6)	(1.5)	(0.7)	(0.8)
(Number of schools)	(36)	(37)	(37)	(38)	(35)	(32)

This information also has implications for curriculum development projects. If curriculum materials are developed which require extensive use of laboratory equipment and materials, there will be many schools where the science teachers will not have laboratory assistants to assist in the preparation, tidying up, etc. of the equipment and materials. These tasks, which are largely non-professional ones, will need to be done by the teachers instead to the possible detriment of their professional tasks.

Lesson preparation

Next we will consider some information on various teacher activities which are related to the basic teaching role. Tables 15 and 16, respectively, set out the number of hours per week spent by teachers on lesson preparation, and on marking papers and examinations.

Table 15 : Time spent per week by teachers on lesson preparation

	NSW %	Vic. %	Qld. %	SA %	WA %	Tas. %
Up to 3 hours	16	27	18	16	21	25
4– 6 hours	37	41	36	33	35	39
7–10 hours	32	22	31	33	25	26
11–15 hours	10	8	11	14	12	8
More than 15 hours	5	2	4	4	7	2
(Mean number of hours)	(6.8)	(5.6)	(6.6)	(7.1)	(6.9)	(5.9)
(Number of teachers)	(251)	(263)	(277)	(368)	(265)	(207)

Question: How many hours a week *on the average* do you spend in preparing lessons?

Table 16 : Time spent per week by teachers on marking papers and examinations

	NSW %	Vic. %	Qld. %	SA %	WA %	Tas. %
Up to 3 hours	63	54	53	29	42	44
4– 6 hours	30	35	37	51	41	43
7–10 hours	6	10	7	16	12	12
11–15 hours	1	1	2	3	5	1
More than 15 hours			1	1		
(Mean number of hours)	(3.1)	(3.5)	(3.7)	(4.8)	(4.3)	(3.8)
(Number of teachers)	(252)	(265)	(275)	(366)	(265)	(207)

Question: How many hours a week *on the average* do you spend on marking papers and examinations?

These were difficult questions for IEA to prepare, and for teachers to answer. The results do not give a clear answer to the amount of time spent by teachers on the preparation of science lessons or on marking science tests, etc., since many teachers of science in the sample also taught subjects other than science. Further, some of the lesson preparation and marking would have been done in school hours, and some out of school hours.

Another complication is that teachers may bias their responses to this question, perhaps claiming more work than was actually done! However, if we assume that such biasses operate in a similar fashion across all the states, relative comparisons may still be made between states.

There is a very strong similarity between the state patterns in Table 15. For Australia overall, teachers of science spent an average of 6.5 hours per week on lesson preparation. The patterns in Table 16 are less similar; the Australian average was 3.9 hours per week.

If we assume that a teacher of science receives an average of about 3½ hours per week in school hours for lesson preparation and marking, we can estimate that the teacher spent about 7 hours per week on these activities out of school hours.

A comparison of the Australian figures with those of other countries (in Table 17) shows that, on average, the Australian teachers of science spent less time on these activities than many colleagues overseas.

Table 17 : Teacher lesson preparation and marking : other countries

Country	Lesson preparation Hours/week	Marking papers & examinations Hours/week	Total Hours/week
Australia	6.5	3.9	10.4
England	6.0	5.4	11.4
Japan	8.2	5.5	13.7
New Zealand	6.3	3.3	9.6
Sweden	10.0	4.1	14.1
USA	8.1	5.7	13.8

Perceived syllabus freedom

Another aspect of the teacher's role is the extent to which there are perceived restrictions on the teacher's freedom to adapt the syllabus to suit particular teaching styles or student needs. Table 18 sets out the teacher responses to this question in 1970.

Table 18 : Restrictions perceived by teachers on syllabus freedom

	NSW %	Vic. %	Qld. %	SA %	WA %	Tas. %
A	31	54	24	47	41	53
B	12	15	12	17	13	19
C	57	31	64	36	46	28
(Number of teachers)	(248)	(255)	(272)	(362)	(262)	(204)

Question: Do you feel that there are restrictions on your freedom to adapt the teaching syllabus to suit your particular style of teaching and the needs of your students? If so, what is the source of the authority determining the restrictions?
A. I feel no restrictions.
B. I feel restrictions, determined by authorities within the school.
C. I feel restrictions, determined by authorities outside the school.

There is considerable variability between states in the percentage of teachers perceiving no restrictions. This percentage is relatively high in Victoria, South Australia and Tasmania, and relatively low in New South Wales and Queensland. The percentage of teachers perceiving restrictions determined by the school is fairly constant. Most of the perceived restrictions are determined by authorities outside the school.

Professional development

It is also of interest to consider some aspects of the professional development of the teachers of science which are less directly related to daily classroom responsibilities.

The teachers were asked whether they felt the need for refresher courses in science. The first row of entries in Table 19 indicates that a large majority of science teachers felt that they needed refresher courses. At this stage of the analysis we do not know the characteristics of the teachers who did not desire refresher courses.

Table 19 : Teachers' need of refresher courses in science

	NSW %	Vic. %	Qld. %	SA %	WA %	Tas. %
Refresher courses in science needed	83	87	96	86	85	87
(Number of teachers)	(247)	(258)	(272)	(365)	(262)	(207)
Refresher courses needed in science itself	93	91	91	88	84	93
Refresher courses needed in science teaching methods*	87	92	95	95	91	92

* Note: These are percentages of the teachers, in the first row, who indicated that they needed refresher courses in science.

The next two rows of Table 19 show the percentages of the teachers in the first row who indicated that they needed courses in science itself, and in science teaching methods, respectively. The table indicates a strong demand for refresher courses of both types.

Table 20 shows that most science teachers did attend a conference in education in the preceding 12 months. However there was still a gap between the good intentions of Table 19 and the actualities of Table 20.

Table 20 : Attendance of science teachers at conferences

	NSW %	Vic. %	Qld. %	SA %	WA %	Tas. %
Yes	41	70	66	67	71	51
No	59	30	34	33	29	49
(Number of teachers)	(245)	(255)	(271)	(362)	(263)	(200)

Question: During the last 12 months did you attend any conference in education in an area related to your teaching field?

One indicator of the professional growth of a science teacher is participation in science curriculum development projects. Table 21 shows the percentage of teachers participating in this way in 1970.

Table 21 : Teacher participation in a science curriculum project

	NSW %	Vic. %	Qld. %	SA %	WA %	Tas. %
Yes	15	30	25	36	39	36
No	85	70	75	64	61	64
(Number of teachers)	(247)	(256)	(267)	(363)	(260)	(205)

Question: Have you taken part in the last 5 years in any science curriculum revision project? (For example, by using and reporting back on trial materials.)

Another indicator is the teacher's reading of subject journals or periodicals, shown in Table 22. Although this was a difficult question to respond to, the pattern of results is similar across states. There is some dissonance between the results of Tables 19 and 22. The majority of teachers felt the need for refresher courses in science but did not read science journals regularly.

Table 22 : Reading of subject journals by teachers

	NSW %	Vic. %	Qld. %	SA %	WA %	Tas. %
Regularly (each week)	33	29	30	28	23	30
Occasionally (several times a year)	59	63	61	58	61	61
Rarely or never	8	8	9	14	16	9
(Number of teachers)	(248)	(258)	(274)	(364)	(264)	(205)

Question: How often do you read journals or periodicals on a subject related to your teaching field?

Professional associations

The final indicators refer to membership of professional associations. Most science teachers belonged to a general teachers association, such as a teachers union or federation, as shown in Table 23. The pattern is similar across the states.

Table 23 : Membership of general teachers association

	NSW %	Vic. %	Qld. %	SA %	WA %	Tas. %
Yes	77	78	93	78	77	82
No	23	22	7	22	23	18
(Number of teachers)	(253)	(263)	(275)	(368)	(265)	(207)

Question: Are you a member of a *general* teachers' association or union or federation?

Of special interest to science teachers is the percentage of science teachers who belonged to a subject-matter association. For most of the respondents in the Australian sample, this question would be regarded as referring to their state Science Teachers Association. Table 24 sets out the percentages. For Australia overall, only about two-fifths of the teachers of science belonged to their own professional association.

Table 24 : Membership of subject teachers association

	NSW %	Vic. %	Qld. %	SA %	WA %	Tas. %
Yes	34	37	48	41	23	41
No	66	63	52	59	77	59
(Number of teachers)	(252)	(261)	(276)	(368)	(264)	(207)

Question: Are you a member of a *subject-matter* teaching association such as a Science Teachers Association?

The typical Australian science teacher

Let me summarise the data in this paper by sketching a picture of the typical Australian science teacher in 1970.

He, for our typical science teacher was male, was 30 years old. He had 3½ years tertiary education, during which he studied physics, chemistry and biology to the first-year level, but didn't study geology.

He had been teaching 8½ years. His present school, where he had been for 4 years, had an intake of 180 students into the first form of the secondary school.

There was one laboratory assistant at the school, which was just as well since the practical classes contained 30 students each.

He spent 6½ hours a week preparing lessons and 4 hours a week marking tests generated from these lessons.

He felt the need for refresher courses to bring him up-to-date in both science itself and science teaching methods. He attended a conference on education last year, but had not yet been asked to carry out trials on new curriculum materials.

He belonged to the state teachers union, but although he occasionally read science journals, he hadn't yet joined his state Science Teachers Association!

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About the Contributor

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